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TOWARDS CONCEPTUAL AND THEORETICAL FOUNDATION FOR IDENTIFYING PROBLEMS, CHALLENGES AND MECHANISMS FOR MUNICIPAL WASTE MANAGEMENT IN DEVELOPING COUNTRIES

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ABSTRACT: This article reviews conceptual and theoretical issues in municipal solid waste management. Definitions and explanation of different concepts in municipal solid waste management are assessed. This article also examines the integrated sustainable waste management framework to determine its relevance in developing countries context. It further analyses measures by different stakeholders in coping with the problems of solid waste management practices and factors that influence the choice of the coping mechanisms. Finally the article provides a synthesis in form of a conceptual framework that may be adopted in aiding in formulation and design of sustainable municipal solid waste management practices.

KEYWORDS: Waste, Waste management, Municipal waste, Integrated waste management system.

1 INTRODUCTION

The process of urbanization is one of the most important drivers of economic, social and physical change in developing countries such as those in Sub-Saharan Africa (Pieterse 2008). Rakodi (1997) argued that it is "almost a truism that the planet's future is an urban one and that the largest and fastest growing cities are primarily in developing countries." The United Nations Centre for Human Settlements- UNCHS (now UN-Habitat) (2001) report indicated that approximately 25 percent of continent Africa's population lived in towns and cities in 1975. In the year 2000, due to the combined effects of rural-urban migration and rapid rates of natural population increase, 38 percent of the continent's population lived in urban areas and the proportion is expected to increase to 47 percent by 2015, and to double by 2050 (UN-Habitat 2009; Hall and Pfeifer 2000). The increase in the world urban population has led to challenges in the provision of public services. One of the most pressing issues in global cities is solid waste management. In spite of the data issues, it is clear that most cities' waste quantities are increasing rapidly. The reasons behind this is the fact that the population in the urban areas is increasing hence waste, the amount of waste is increasing with the increase wealth, the amount of waste from businesses is increasing and the substances in waste are also increasing in complexity and variety (U.N Habitat 2010).

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2 CONCEPTS OF WASTE

Waste

As noted by Palmers 2005 "the term waste is frequently left undefined, primitive in spite of its critical importance" and "in most cases a list of what is included in waste is substituted for underlying definition". This is clearly evident, for instance Zerbok (2003) defines solid as non- hazardous industrial, commercial and domestic refuse including household organic, street sweepings, hospital and institutional garbage and construction waste.

The revised oxford dictionary defines waste as unused material or substance produced while making something. The word net dictionary on the other hand defines waste as any material unused and rejected as worthless or unwanted. Gilpin (1996) defines waste to be "all unwanted and economically unusable by products or residuals at any given place and time, and any other matter that may be discarded accidentally or otherwise into the environment". The common idea in these definitions is that "waste is any material that is considered not of worth anymore and should be disposed off". However, it should be noted that not all materials that are considered as not of worth anymore to the current holder are discarded, some are kept and are later passed on to another user (either for free or at some amount) to whom the materials become raw materials.

Palmer (2005) defines waste to be "any object whose owner does not want to take responsibility for it". This definition implies that anything that does not have a owner should be considered as waste regardless of whether its new or in a condition which it can be recycled, however if someone is ready to take responsibility of that material then it's no longer considered as waste. This notion that waste to one person can be a resource to another corroborates with Davies (2008) whose definition noted that "what some people consider to be waste materials or substances are considered a source of value by others"

USEPA (2000) regulatory gives a broader definition of waste. It defines solid waste to include items discarded, things destined for reuse, recycling, or reclamation, sludge and hazardous waste excluding radioactive waste and mining waste.

Solid waste management is guided by principles such as "to minimize waste generation, maximize waste recycling and reuse, and ensure the safe and environmentally sound disposal of waste" as identified by Schubeller et al. (1996). This means that waste management should be approached from the perspective of the entire cycle of material use which includes production, distribution and consumption as well as waste collection and disposal. While immediate priority must be given to effective collection and disposal, waste reduction and recycling should be pursued as equally important longer-term objectives.

Having looked at the definitions above by different authors it is good to come up with a definition of solid waste that will be adapted in this article, "waste is any material that the holder considers of no value in its present form and therefore is no longer willing to take its responsibility regardless of whether the material has fulfilled its purpose or not and if possible, the holder is willing to discard be it to another holder to whom it may have value or to waste disposal points".

Municipal solid waste (MSW)

As noted with the definition of waste, instead of defining what municipal solid waste, some authors substitute the definition of municipal solid waste with a list of what is included in municipal solid waste, for instance Zurbrugg (2002) in his definition of municipal solid waste just provided a list of what is included in municipal solid waste. According to him municipal solid waste include "product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries all which comes from industrial, commercial and institutional establishment (including hospitals), market waste, yard waste, and street sweeping" also Cointreau (1982) defines municipal solid waste as non-air and sewage emissions created within and disposed of by a municipality, including household garbage, commercial refuse, construction and demolition debris, dead animals, and abandoned vehicles, municipal solid waste is generally made up of paper, vegetable matter, plastics, metals, textiles, rubber, and glass. Schübeler, Wehrle and Christen (1999), Zerbok (2003) in their work added that hazardous waste and hospital waste by definition are not categorized under municipal solid waste but however it is difficult to separate them especially when their portions are small and that and also in most cases they end up in the municipal solid waste system.

This article will adapt the definition of municipal waste to be "any material that is no longer considered of importance to the owner in the present form/condition and the owner is willing to discard it if possible and this material must have its source in the urban areas mainly from the residential areas and commercial enterprises." This definition implies that all the solid wastes not produced in the urban areas are not considered municipal solid waste; also that the form of material can be changed in to another form making the same material a resource to another person.

Management on the other hand is a "cyclical process of setting objectives, establishing long term plans, programming, budgeting, operation and maintenance, monitoring and evaluation, cost control, revision of objectives and plans and so forth" Schübeler et al (1999). Municipal solid waste management therefore entails the whole process of collection, transfer, treatment, recycling, resource recovery, and disposal of solid waste in urban areas. This article will adapt Skitt (1992) definition of municipal solid waste management (MSWM) which entails "the purposeful, systematic control of generation, storage, collection, transport, separation, processing, recycling, recovery and disposal of solid waste" specifically in urban areas.

MSWM is a relevant service since solid waste is inevitable based on the fact that human beings produce waste at all levels of development both in the economic as well as in the social activities of life Karanja (2005)

The overall goal of urban municipal solid waste management is to collect, treat and dispose of solid wastes generated by all urban population groups in an environmentally and socially satisfactory manner using the most economical means available World Bank (2011), protecting the urban population from suffering from the impact of poor waste management such as diseases caused by poor waste management which include lung diseases as a result of air pollution from the decomposing solid waste and burning pollution among other diseases.

http://urbanindia.nic.in/publicinfo/swm/chap2.pdf and other authors gave an outline of the specific goals of municipal solid waste management which include:

- Promoting environmental conditions by controlling air water and land pollution as well as ensuring sustainability of various ecosystems in urban areas.
- To support urban economics a development by providing demanded waste management services and ensuring the efficient use and conservation of valuable materials and resources Schübeler et al (1999).
- Valorization of recyclable and organic materials – according to U.N.Habitat (2010) waste is a resource and the entire waste system should be designed to maximize the benefits from the discarded materials.

Having looked at the definitions of waste, municipal waste and municipal waste management, its relevance and goals in the discussion above, the discussion below will focus on Integrated Sustainable waste management.

3 INTEGRATED SUSTAINABLE WASTE MANAGEMENT (ISWM)

ISWM was first developed by a Dutch N.G.O called WASTE in the mid 1980s, it was further developed in 1990s by the collaborative working group on solid waste management in low and middle income countries and has of late become like a norm as far as solid waste management is concerned (Imad, 2011).

Before embarking on elaborating the concept of ISWM, it is necessary to have a clear understanding of what entails the terms 'integrated solid waste management' and sustainable waste management' both which are coined to make the concept of ISWM. Below is a discussion on what the terms 'integrated solid waste management' and 'sustainable waste management' entails.

Integrated solid waste management

Conventional solid waste management consisted of collection, followed by transportation, and disposal of waste. However this approach of waste management has not been able to cope with the challenges of rapid urbanization and waste evolution. This has therefore called for an approach that includes innovative techniques to enhance the capability of the system to cope with the challenges of increasing volume of waste. The innovative techniques therefore should be able to regulate waste generation, recovering materials for recycling, producing energy as well as reducing hazardous effects for more safe and efficient disposal. Solid waste management systems that integrate innovative system for the sake of sustainability of solid waste management system are called integrated solid waste management system Penjor (2007). Klundert and Anschutz (1999) and (2001) on integrated waste management noted that an Integrated system is "that system which uses a range of inter-related collection and treatment options, at different habitat scales (be it household, neighborhood or city), involves all stakeholders i.e. governmental or non-governmental, formal or informal, profit- or non-profit oriented and takes into account interactions between the waste management system and other urban systems as outlined in World Bank (1999). White et al (1999) points out that an integrated solid waste management system deals with all types of waste materials- the alternative of focusing on specific materials , all sources of municipal solid waste and a system that include waste collection and sorting followed by one or more options of recycling, biological treatment of organic materials, thermal treatment or landfill.

From the above definitions it can be concluded that an integrated solid waste management is 'the approach of solid waste management that takes the solid waste management system as a whole and not in compartments. An integrated system therefore includes all kinds of waste regardless of whether they are recyclable or not, all the stakeholders and importantly involves all the innovative waste management techniques'.

However good and beneficial integrated solid waste management is ,it is an approach that is prone to criticism since solid waste management is made up of different compartments and integrating all of them sometimes can be impractical depending on the setting where it is being implemented.

Sustainable waste management

Sustainable waste management is an integral part of sustainable development (Brundtland Commission's approach to development which seeks to "meet the needs of the present without compromising the ability of future generations to meet their own needs") WCED (1987) because the amount of waste generated and how it is managed has profound implications for the quality of the environment and for the prospects of future generations. This therefore means that in keeping with the objectives of sustainable development, sustainable waste management can be regarded as an approach to waste management that, in addition to achieving its main goal which is to protect human health and the environment, ensures that the limited resources of the earth are conserved for both present as well as the future generations. It therefore becomes important to minimize the amount of natural resources that human beings extract as well the consumption by recycling waste materials, and conduct waste management efficiently to curtail the environmental impacts of waste disposal and protect ecosystem services for both current and future generations Baabereyir (2005). Klundert and Anschutz (1999) and (2001) in their definition of SWM points out that it means a system that is appropriate to the local conditions in which it operates, from a technical, social, economic, financial, institutional, and environmental perspective, and; capable to maintain itself over time without reducing the resources it needs as noted by a definition which corroborates with that of World Bank (1999). It can therefore be concluded that a sustainable waste management system is that which takes into respect sustainable development aspect of producing more with less and should be appropriate to local context so that it can be in a position to maintain itself for a long time and can be achieved through the minimization of waste impacts in terms of quantity or negative impacts, by reducing the volume of waste, reusing the waste products with simple treatment and recycling the waste by using it as resources to produce the same or modified products.

Having explained the terms integrated waste management and sustainable waste management, below is a discussion on integrated sustainable waste management.

Integrated sustainable waste management

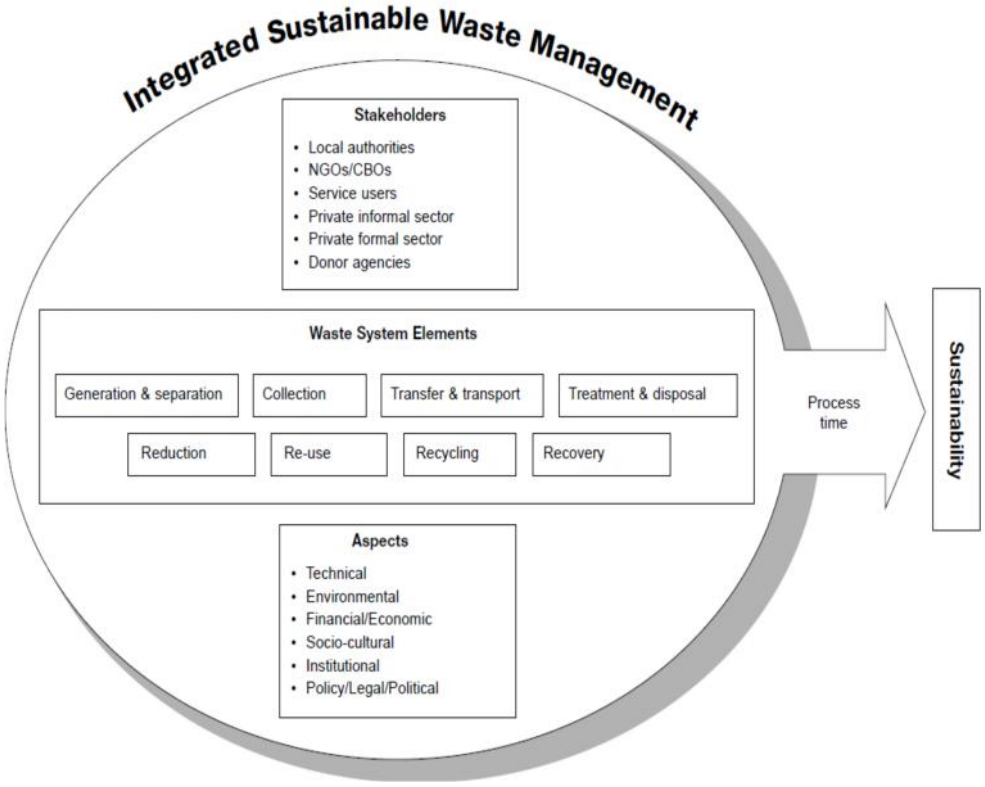
According to UNEP (2009) integrated sustainable waste management refers to the strategic approach to sustainable management of solid wastes covering all sources and all aspects, covering generation, segregation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximizing resource use efficiency. The core concept of ISWM has been developed out of experience to address the certain common problems with the municipal waste management, Klundert and Anschutz (2000). Klundert and Anschutz (2000) continue to explain that ISWM is a waste system that fits the society, the economy and the environment of a particular place. Klundert and Anschutz (2001) in further explanation of ISWM indicates that ISWM differs from the traditional approaches to waste management since the new approach gives room for participation of other stakeholders in waste management and also inclusion of the elements of waste prevention and waste recovery which was not the case in the traditional approaches to waste management where the mandate of waste management was all laid on the hands of the municipal government and the elements of waste reduction and recovery were all missing.

3.1 The dimensions of integrated sustainable waste management

ISWM is a system approach recognizes three main dimensions including stakeholders, system elements and strategic aspects. The different dimensions are interrelated and their linkages enable the overall function of the system, U.N Habitat (2010). It can therefore be concluded that ISWM considers municipal solid waste management not just as technological system with infrastructure and facilities that facilitates handling and disposal of municipal solid waste (MSW) but is a management system that contributes and deals with many other elements such as socio economic, environmental among others (Imad, 2011) and Klundert and Anschutz (2001)). The above statement corroborates with U.N.Habitat (2010) where it is stated that when the ISWM framework was introduced in developed countries, it became clear to the municipalities that solid waste management problems were not solely technically based since the success of waste management requires active cooperation from the service users and also that solid waste depends on institutions, government and policy frameworks.

Figure one below gives an outline of the main dimensions of the ISWM framework as outlined by Klundert and Anschutz (2001) followed by a discussion on the three dimensions.

Figure 1: ISWM framework



Source: Adapted from Klundert and Anschutz (2001)

The discussion below is on the three dimensions of integrated sustainable waste management starting with the stakeholders, then to system elements and finally strategic aspects.

Stakeholders

The number and type of stakeholders regarded as essential to solid waste management has been growing and broadening over time. While traditionally waste management was the responsibility of the local government, the private and community sectors are increasingly taking over certain tasks, Lardinolois and Furedy (1999). As anticipated by Corinne et al (1999) that the environmental problems of cities that are associated with poor solid waste management can be addressed in large part by the interaction of several actors/ stakeholders, ISWM one of the approaches for solving the problems of SWM in urban areas recognizes high interaction between multiple stakeholders. According to Imad (2011), stakeholders are the people and organizations participating in solid waste management, this definition corroborates with Majale (2011) who stated that stakeholders in waste management are people or organizations who have a stick or are interested in good solid waste management and their involvement and activities makes that possible. Anschutz et al (2003) elaborated on the subject and stated that stakeholders in waste management differ with cities; this creates the need for their identification in every context. Joseph (2006) in support of this statement stated that identification and participation of different stakeholders in each city as well as their interests is paramount in their coordination in solid waste management.

Broadly, stakeholders in solid waste management can be categorized under state and non state actors. State actors are generally the local municipal governments while as the non state actors include the nongovernmental organization, community based organizations and the private sector both formal and informal as discussed below;

Municipal governments

Local Municipal governments have the role to plan and provide public services within their areas of jurisdiction solid waste management included. In most cases the local municipal governments both from the developed and developing countries receive their powers and responsibilities from the central government, all geared towards protecting the rights of the citizens and providing services for the common good of the citizens. In their day to day activities local municipal authorities also ensure the implementation of laws and regulations, Gidman et al. (1995).

However due to some reasons such as financial constraints, the local authorities may outsource the services to the private sector, but however, the local authority always holds the responsibility of ensuring the quality of the service, Majale (2011).

Non-Governmental Organizations (N.G.Os)

These encompass a diverse range of organizations such as churches, universities, environmental or social organizations and lobbies (Lardinolois and Furedy, 1999).

Non Governmental Organizations play different roles in waste management. These roles include education, advocacy, liaising between small C.B.Os and individuals who do waste collection and large scale private companies. In terms of education, some NGOs seek to facilitate community exchanges for instance they bring people from different communities where they can exchange information and innovation with one another. NGOs, also in some countries mandate schools to provide environmental education and waste recycling. What happens is that these schools bring students of school age in the waste recycling plant where the member of the N.G.O takes them through a program on waste management.

N.G.Os acts as liaisons between the community and the City, as well as between the community and the private sector. In most of the cases the N.G.Os are usually in contact with leaders of C.B.Os and relay the information back to the City.

Community Based Organizations (C.B.Os)

The community members and their representatives have a direct interest in solid waste management. In developing countries especially in the low income areas, the community receives little if not no solid waste management services (Karanja, 2005). Sometimes the communities organize themselves in to a Community Based Organization with a direct goal of improving the state of the solid waste management within their areas (Gidman e t al. 1995). C.B.Os in waste management also plays a role of community organization, education, collection and small business development. C.B.Os, are organized to create income generating activities in waste. In most cases C.B.Os are organized by local community leaders who play an important role in solid waste management by organizing and educating their community about issues and opportunities in solid waste. Sometimes, the CBOs take the overall role of providing solid waste management services hence in this situation they operate and maintain solid waste management systems within their areas of operation.

Formal private Sector

The “formal private sector” refers to privately-owned corporations, organizations, firms and/or institutions. Formal private sectors must be formally registered with the city and have official business licenses as well as have some level of capital investment and necessary equipment related to waste management. The main objective of the formal private sector is to gain profit from the variety of activities they are engaged in which include waste collection, resource recovery, incineration and landfill operation (Gidman et al. 1995). Private sector can be sub-dived in to two categories-small scale private business that basically have in most cases one vehicle which helps them in the whole process of transferring waste and large scale private business which are large firms with a fleet of vehicles and large capital infrastructure.

Individual and/or informal sector actors

The term ‘informal private sector’ refers to unregistered, unregulated, or casual activities carried out by individuals and/or family or community enterprises that engage in value adding activities on a small-scale with minimal capital input, using local materials and labor-intensive techniques” (Gidman e t al. 1995).The difference between the formal private sector and the informal private sector is that the informal private sector is most of the times driven by poverty, their activities are also labor intensive and are performed in a haphazard manner.

System elements

Elements of solid waste management comprises of technical components of waste management starting from the generation of solid waste to dumpsites or to the treatment plant (Imad, 2011). Klundert and Anschutz (2001) stated that ISWM framework recognizes the high-profile elements collection, transfer and disposal or treatment. The framework gives

equal weight to the less well understood elements of waste minimization, reuse and recycling and composting. Below is an explanation of the various waste management system elements.

Waste generation

Waste generation refers to the process in which waste is formed. Bringi (2007) noted that waste generation "includes all the activities where a product is considered as no longer important and the owner is willing to discard that waste". It is also noted in http://urbanindia.nic.in/publicinfo/swm/chap2.pdf that "both technological processes and consumptive processes result in the generation of waste." Bringi (2007) further explains that the waste generated in one place may significantly differ from that generated in another place due to factors such as "geographic location Season of the year, frequency of collection, characteristic of population, extent of salvage and recycling, legislation and public attitudes"

Sorting and waste handling

Sorting involves the process of separation of waste with different characteristics. Waste handling takes two levels, the first one involves "activities associated with management of wastes until they are placed in storage containers for collection" while as the second level "involves the movement of loaded containers to the point of collection" as noted in http://urbanindia.nic.in/publicinfo/swm/chap2.pdf.

Storage

Waste storage takes two levels i.e. on-site storage which involves the activities of storing waste at individual level. The other level involves storing of waste at a communal storage point, Bringi (2007).

Collection

Solid waste collection is a critical part of a local waste management system, Tchobanoglous and Kreith (2002). Solid waste collection involves gathering of solid waste before transporting it to the place where the collection vehicle is emptied. The process starts with the containers holding materials that a generator has designated as no longer useful and ends with the transportation of solid waste or recyclable materials to a location for processing, transfer, or disposal (Tchobanoglous and Kreith, 2002).The collection system is uniform in most countries, wherein individual households place their daily refuse into a container nearby, then the refuse is collected and delivered to the waste collection point or disposal site. Zerbok (2003) noted that many cities employ neighborhood-level collection points.

Transportation of waste

Transportation of waste refers to the use of any transportation facilities to move waste to a transfer station, processing or to the disposal facility (Bringi, 2007). Bringi (2007) continues to explain that "the transportion of collected waste is a major problem in developing countries since the vehicles spend most of operation time on transporting wastes to the disposal sites due to traffic and road conditions and a small payload".

Reduce, Reuse, Recycling and Recovery

Bringi (2007) as many other authors on solid waste management noted that reduce, recycle, reuse and recovery are important aspects in solid waste management due to their major contribution to sustainable waste management. He continues to explain that the four functions are more successful in developed where waste management technology is considerably advanced than in the developing countries.

Processing and Treatment

Processing involves the technological activities of trying to get something out of the waste .

Disposal

Disposal is the final element of solid waste management system; it entails the activities of disposing of waste which takes different forms such as sanitary land filling and open dumping which dominates most of the urban areas in developing world (Bringi, 2007).

Strategic aspects in waste management based on ISWM

As mentioned earlier, Klundert and Anschutz (2001) and Imad (2011) stated that to achieve sustainable and effective waste management, strategies must go beyond technical aspects to formulating specific objectives and implementation of appropriate measures to a focus on financial, environmental, institutional and political aspects of municipal solid waste management. The following section discusses various aspects of ISWM.

Technical aspects

Technical aspects of integrated sustainable waste management are concerned with the planning and implementation and maintenance of collection and transfer systems, waste recovery, final disposal and hazardous waste management (Lardinolois and Furedy,1999). Technical facilities and equipment must be designed and selected with careful regard to their operating characteristics, performance, and maintenance requirements and expected life-cycle costs as well as paying close attention to preventive, maintenance, repair and spare parts availability. Thereby, one has to take into consideration the design and selection of transfer facilities and equipment must match the characteristics of local collection systems and the capacity of existing disposal facilities (Majale, 2011). Local collection systems should be designed with active participation of the communities concerned. Informal waste recovery and scavenging may be rendered more productive through support measures and appropriate technical design of the waste management systems. Public sector involvement in waste recovery and/or leasing of waste recovery rights to private sector enterprises may be considered. Sources of hazardous waste materials must be identified, registered and targeted for appropriate management; special attention needs to be paid to infectious healthcare wastes (Klundert and Anschutz, 2001).

Financial and economic aspects

Lardinolois and Furedy (1999) noted that financial and economic aspects in solid waste management involves the budgeting and cost accounting within the waste management system which are normally based on the local, regional, national and international economic contexts. Some specific issues are: privatization, cost recovery and cost reduction, the impact of environmental services on economic activities, the commodities marketplace and how the recycling infrastructures connect to it, efficiency of municipal solid waste management systems, macroeconomic dimensions of resource use and conservation and income generation.

Environmental aspects

Environmental aspects in solid waste management pertains the effects of waste management on land, water and air; on the need for conservation of nonrenewable resources; pollution control and public health concerns (Lardinolois and Furedy, 1999).

Institutional aspects

This relate to the political and social structures which control and implement waste management, the distribution of functions and responsibilities, the organizational structures, procedures and methods implicated, the available institutional capacities, and the actors such as the private sector who could become involved. Planning is often considered the principal activity in relation with institutional and organizational aspects (Lardinolois and Furedy (1999).

Political /legal aspects

Political/legal aspects address the boundary conditions in which the waste management system exists: setting goals and priorities, determination of roles and jurisdiction, the existing or planned legal and regulatory framework, and the basic decision making processes (Lardinolois and Furedy, 1999).

Social cultural aspect

The social aspect of solid waste management entails the participation of citizens and the possibilities of public private partnerships in waste management practices (Majale, 2011).

Legal/ political

The legal aspect of solid waste management refers to the policies guiding the whole process of solid waste management (Lardinolois and Furedy, 1999).

Having looked at the three dimensions of integrated sustainable waste management framework, below is a discussion on the principles that guide integrated solid waste management under which one can analyze the problems facing a certain solid waste management system.

Principles of ISWM

There has been a tendency in many municipal functions to move directly from problems to solutions without understanding what actually is happening. This leads to the municipal functions diving in to purchasing of technologies as well as high investments on waste management all which in most of the cases end up being useless.

The principles of ISWM outlined in the table below form a base for the analysis of the problems in SWM so as to have a better understanding of the situation at hand before diving in to solutions. The principles basically outlines what should be the case in a certain SWM system meaning if the opposite is happening definitely there is a problem in that particular part of the system.

Table 1: Principles of ISWM

Strategic aspect	Principles
Technical	**All the technological aspects should be:** • Adapted to the physical environment, topography and other physical requirements • Preferably locally manufactured and based on indigenous technology • Geared towards efficiency and optimum utilization of equipment • Adapted to the local availability of spare parts • Durable and of good quality; the equipment used should have a long expected life span.
Financial/economic	**Financial management of technologies and systems should:** • Be based on the 'all beneficiaries contribute principle', i.e. besides the waste generators paying user charges, the resource recovery sector and the local government should also contribute by respectively paying a profit tax and allocating municipal revenues to waste management • Be geared towards the most efficient overall system, leading to the lowest cost per ton to operate, taking into account the cost of other affected urban systems • Ensure highest productivity of labor and capital in the local situation • Lead to full cost analysis and full cost recovery, including all costs and benefits involved.
Social/cultural	**Technologies and systems should:** • Be provided to all strata of the population regardless of ethnic, cultural, religious or social background • Be adapted to user demands and priorities • Be adapted to local willingness and ability to pay, leading to affordable systems • Incorporate management models which are acceptable to people and institutions involved • Be geared towards improvement of working conditions of system operators • Be geared towards income and employment generation
Environmental health	**Technologies and systems should:** • Be clean, i.e. minimize the negative impact on soil, air and water at local, regional and global level • Promote closed cycle systems and avoid loss of raw materials, energy and nutrients • Follow the 'waste management hierarchy', preferring options that promote waste prevention, source separation, re-use and recycling, above those merely aimed at collection and disposal • Encourage treatment and resource recovery as close to the source as possible • Minimize risks to public health
Institutional	**Technologies and systems should be:** • Geared towards capacity-building of operators and managers, especially of local authorities • Creating room for involvement of all stakeholders in planning and implementation, especially weaker and underprivileged groups • Encouraging 'social privatization' • Promoting organizational cultures that foster professionalism, transparency and accountability • Based on decentralized management, giving sufficient regulatory and financial autonomy to local governments to improve waste management sustainably • Ensuring competitive bidding for waste service provision by private sector • Encouraging incentives, recruitment and promotion based on merit and performance • Promote inter-sectoral co-operation (with other urban systems)

Legal/policy	**Technologies and systems should be supported by:** **A legal framework that:** • Encourages involvement of non-governmental actors and the private sector • Supports decentralization of tasks, authority and finance • Contains rules and regulations that are transparent and unambiguous • Enables impartial enforcement of rules and regulations **A policy framework at national and local level that:** • Encourages decision-making at the lowest level of authority, usually the municipality, regarding financial matters and selection of technologies • Gives waste management high priority both in policies and budgets • Recognizes waste management as an environmental health issue, that necessitates equity in service provision • Recognizes the role of non-governmental actors and the private sector in waste management • Fosters accountability of decision-makers to ensure efficient use of public funds • Supports the 'waste management hierarchy', giving preference to waste prevention, source separation, re-use and recycling, above mere collection and disposal

Source: Adapted from (Klundert and Anschutz, 1999) and (World Bank, 1999).

Regardless of the fact that most of the principles outlined above apply to many contexts, the opinion of the author of this work is that not all these principles apply to each and every context e.g. one of the principles is that the technology is preferred when locally manufactured, this cant apply in all countries since very few countries manufacture such things as transfer vehicles and therefore they have to rely on the imports from other countries.

Cointreau (2001) gives a summary of the above outlined principles in her ten principles that should guide a sustainable and integrated solid waste management program. According to her scheme, such a program should: be supportive of good governance, provide economic service delivery, establish cost recovery mechanisms for long-term financial sustainability, conserve natural resources, embrace public participation, foster environmentally appropriate technologies and sites, seek appropriate levels of source segregation, recycling and resource recovery, conduct strategic facility planning and development ,build institutional capacity and invite private sector involvement

Having looked at the dimensions of integrated sustainable waste management i.e. the stakeholders, strategic aspects and the system elements and also the principles that guide ISWM, the following discussion is about the problems in solid waste management particularly in developing countries.

4 PROBLEMS IN SOLID WASTE MANAGEMENT IN DEVELOPING COUNTRIES

The quantity of solid waste is generally considered to be growing across the globe as a result of increased population, increased industrialization, and increased urbanization and rising standards of living among other factors, UNEP (1994). However developing countries have solid waste management problems different from those of countries that are fully developed. Indeed, the composition of their waste is different from those of developed countries (Zerbok, 2003).

As noted by Ogawa (2002) "solid waste management in developing countries is coupled by problems which low collection coverage and irregular collection services, crude open dumping and burning without air and water pollution control, the breeding of flies and vermin, and the handling and control of informal waste picking or scavenging activities". This scenario has led solid waste management to be inefficient and improperly performed by many urban areas in developing countries.

Zurbrugg and Schertenieib (2002) and Zebrok (2003) in their discussion gave umbrella of problems in the sector of solid waste management. According to them problems in SWM can be explained under inadequate service coverage, operational inefficiencies, and inadequate management of hazardous waste and limited utilization of recycling activities. Ogawa (2002) on the other hand categorized problems in the sector of solid waste management into technical, financial, institutional, economic, and social constraints. However as it will be noted in the discussion below, the umbrella problems are well explained by the specific problems outlined above, in fact some of the umbrella problems are impacts of the specific problems.

The following discussion may not cover all the problems but will try to summarize those that affect the people, residents, waste workers, policy makers and decision makers and governments in the cities and urban residential areas in typical developing countries.

However as noted in the discussion above, some authors look at the problems facing solid waste management sector as specific problems while the others take them as umbrella problems. The discussion below will therefore look at the specific problems and then the umbrella problems.

4.1 Specific problems

Financial constraints

Many writers have cited scarcity of funds as a major problem in the field of solid waste management, Contreau (2001) and Majale (2011). Financial constraints can be defined as the imbalance between the revenues and expenditures in the sector. Financial constraints in the sector of solid waste management can be attributed to various reasons as discussed below;

With increasing urbanization, demands for services will logically increase. Municipal tax and fee revenues however are not likely to rise as quickly as the population, this is explained by the fact that people moving to the city are likely to be poor immigrants from rural areas in search of employment, unable to contribute significantly to the revenues of the municipality. Zurbrugg and Schertenieib (2002) on their argument on financial constraints in SWM stated that financing safe disposal of waste management in developing countries have become an issue because people are just willing to pay for removal of waste at their site but they don't care about the ultimate disposal.

Inadequate resource mobilization is another factor that is attributed to the financial constraints in the field of solid waste management. In most cases, municipal taxes and charges in developing countries are inadequately and poorly administered. Informal urban communities which characterize the small and medium towns in developing countries pay no municipal taxes and service charges, and this fact has often been used as a principal argument of not providing these communities with municipal services (Coffey & Coad, 2010).

Low budgetary allocation from the central government is another factor contributing to financial constrains in the field of solid waste management. In developing countries the local government is charged with the responsibility of providing solid waste management among other municipal services. As noted in many studies on solid waste management, solid waste "solid waste management is not one of the public services that is given high priority especially in developing countries." As a result, very limited funds are provided to the solid waste management sector by the government (Ogawa, 2002). On top of the low budgetary allocation from the central government, the transfer is also conditional; this limits the relative autonomy of the councils in deciding their immediate needs (UNEP, 2005).

Technical constraints

Many researchers and writers on the subject have observed that developing countries employ the technology that is neither efficient nor sustainable. Zurbrugg (2002) and Majale (2011) noted that the local authorities in developing countries import technology from developed countries. This has a direct impact on the operation and maintenance of the imported technology. This is due to the fact that the developing countries don't have the technological knowhow on how to operate and maintain the imported technology, the other factor is that the imported technology for instance the vehicles rarely have their spare parts available in the developing countries. The other factor that contributes to the inefficiency of the imported technology is that most of the times they are designed to operate in areas which have different geographical characteristics than where there are used.

Ogawa (2002) on the other hand noted lack of overall plans for solid waste management at local and national levels. Without such plans technology in the sector is often selected without the consideration of whether it is appropriate or not in the overall solid waste management system. Ogawa (2002) also noted that research and development activities in SWM are often low priority in the developing countries. This has led to the selection of technology that is not appropriate to the local climatic and topographic conditions, human and financial capability as well as social cultural acceptability. The result is that such a technology may end up not being used, regardless of the huge amount of time and resources that might have been invested in it (Majale, 2011).

Institutional problems

Ogawa (2002) noted that in most developing world, there is usually more than one body that deals with solid waste management, however, the responsibilities of such each body is not in all cases clear hence cases of overlapping and duplication of the function. Ogawa (2002) continues to explain that coordination between the different bodies responsible for solid waste management is a missing element in developing countries as well as different legislations which are evidently fragmented governing solid waste management.

Social cultural problems

Social problems in the sector of SWM are experienced in both developing and developed countries. However the problems are more complex in the developing countries. As noted by Ogawa (2002) "social status of solid waste management workers is generally rated low a situation which can be explained by the negative perception of people regarding the work which involves the handling of unwanted material".

Political interference

The introduction of multiparty system in some of the countries in the developing world Kenya included has led to political jostling. In Kenya for example, the councilors are selected or nominated by the local authorities through their affiliated political parties and will usually pursue the interest of their political parties when voting or decision making in committee by which they chair. In other words, if a decision has to be made by the councilors it is influenced by the political parties where they belong a scenario which has led to delay of activities in solid waste management. For example in cases of purchasing collection trucks – there are instances where councilors hinder particular projects for political reasons only (Rotich et al 2006).

Environmental health problems

Most developing countries have informal waste collection rates going up to 30-60 % in low income countries and 50-80% in middle income countries, U.N Habitat (2010). The accumulation of waste in the streets creates room for the growth of germs, insects, rats and other disease vectors. In cases where there is no sufficient sanitation infrastructure human excreta might end up mixing with the municipal solid waste hence increasing the complexity of the characteristics. Uncollected waste sometimes also ends up causing clogging in the drainage system which creates a bleeding area for the mosquitoes which spread malaria (U.N Habitat, 2010).

There are also cases of improper solid waste management activities that dominate the developing world. As noted by Majale (2011), low levels of solid waste collection in developing countries have led to people adapting measurers such as burning and open dumping as a way of doing away with waste. These measures are usually associated with some environmental health problems such as respiratory diseases due to the smoke that comes out of the burning waste, environmental(air, ground and surface water and soil) pollution among other environmental health problems (www.epa.gov).

4.2 Umbrella problems

Inadequate Service coverage

Municipal solid waste collection in the developing countries serves only a small portion of the urban population. The inhabitants who are left without waste collection services are usually in the low income population living in the poor conditions of the peri urban areas (Zurbrugg et al 2000).

Operational inefficiencies

Operational inefficiencies are due to inefficient institutional structures, inefficient organizational procedures, or deficient management capacity of institutions involved as well as use of inappropriate technology.

With regard to technical system, collection and transportation of solid waste from their generation sites to the final disposal site is a growing problem. Transport also relies on operation vehicles whereby frequent breakdowns coupled with shortage of spare parts (Majale, 2011) characterize the process. This problem is attributed to overreliance on developed world technical system in waste management. Often the developing countries use similar vehicles as those ones used in developed countries (Zurbrugg and Schertenieib, 2002).These vehicles are usually sophisticated, expensive and difficult to operate and maintain in the developing countries. After a short period of being in use the vehicles start suffering from frequent breakdowns. It is not uncommon for 60% of the vehicles fleet or even more to be unserviceable at any time since it's hard to get the spare parts of these vehicles in the developing countries. These leads to the delay of waste collection or at

times no waste collection at all and thus problems in the whole process of waste management (Coffey & Coad, 2010). With rapidly growing urbanization, less priority is being given by the cities for adequate layout and planning (Zerbok, 2003). Garbage dumps with their associated diseases, odor, and frequent fires (in some cases) would ideally be located on suitable land away from most densely populated areas. These areas are becoming harder to find as population urbanize and municipal traffic increase the transport of waste becomes longer and more time consuming and therefore more expensive and less efficient.

Inadequate waste disposal

Most of the municipal solid waste in developing world is dumped in open dumps which are more or less uncontrolled and makes very uneconomical use of available space and often produce unpleasant and hazardous smoke from slow burning firers (Zhu et al. 2009). These dumps also allows free access to waste pickers, animals and flies and often produces unpleasant smell and hazardous smoke from slow burning fires. With the rapidly increasing urbanization the present situation is expected to become more complicated. Such inadequate waste disposal creates serious environmental problems that may impair health of human beings and animals and cause economic and other welfare losses (Zurbrugg and Schertenieib, 2002).

Some of the reasons attributed to inadequate disposal are the mostly inappropriate guidelines for sitting, design and operation of new landfills as well as missing recommendations for possible upgrading options of existing open dumps. Many of the municipal officials think that uncontrolled waste disposal is the best that is possible. In most cases the only available guidelines are from developed countries which cannot be applied in the developing world since they are sophisticated and expensive and do not take into account for the different technical, economical, social and institutional aspects of developing countries and therefore cannot be implemented n the developing world (Zurbrugg and Schertenieib, 2002).

Limited utilization of recycling activities

According to Zurbrugg and Schertenieib (1999), recycling inorganic materials from municipal solid waste is often well developed by the activities of the informal sector although such activities are rarely recognized, supported or promoted by the municipalities. Reuse of organic waste material often contributes to 50 % of total waste material but still fairly limited but often has great recovery potential (Zerbok, 2003). The advantages of recycling are that it reduces the cost of disposal facilities; it also prolongs the lifespan of the disposal site as well as reducing the environmental impact of disposal of organic material such as leachates and methane problems.

Having looked at a number of problems and challenges in municipal solid waste management, the following part of the article will make an attempt to look at the strategies and options for fixing the problems explained above.

5 COPING MECHANISMS

5.1 Coping mechanisms to the problems facing the field of solid waste management

Municipalities and other stakeholders in waste management take different initiatives to deal with the problems they face in solid waste management, before embarking on the coping mechanisms, the discussion below will start by giving a brief description of waste hierarchy which according to White et al. 1999) has formed the base for current thinking on the best waste management practices which have been applied by municipalities to deal with the problems in MSWM. Other coping mechanisms besides those based on the waste management hierarchy will also be explained in the discussion below.

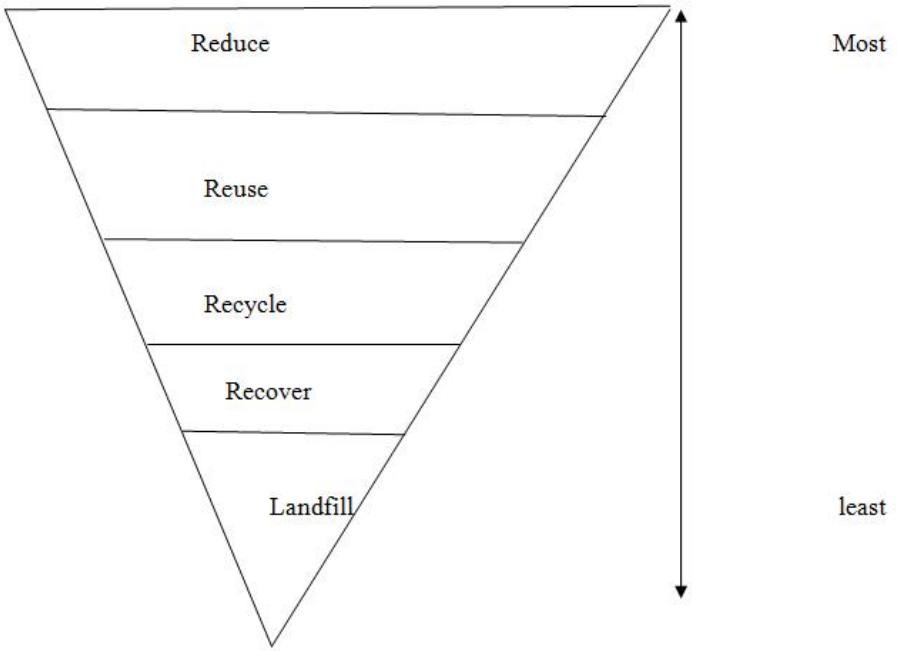
5.1.1 Coping mechanisms based on waste management hierarchy

Before embarking on coping mechanisms based on waste management hierarchy, the discussion below gives a brief explanation of what waste management hierarchy entails.

Waste management hierarchy

Current thinking on the best methods to deal with waste is centered on a broadly accepted 'hierarchy of waste management' (arrangement in order of rank) (urbanindia.nic.in/publicinfo/swm/chap2.pdf), as shown in Figure 2 below. Waste management hierarchy gives a priority listing of the waste management options available (White et al. 1999; Lardinolois and Furedy, 1999). Hierarchy of waste unlike the conventional waste management system which focused on street sweeping, collection, transportation and disposal only focuses to long term environmentally sound or sustainable waste management (Lardinolois and Furedy, 1999).

Figure 2: Waste hierarchy



Adapted from: http://urbanindia.nic.in/publicinfo/swm/chap2.pdf

The hierarchy gives important general guidelines on the relative desirability of the different management options. The hierarchy of waste management options is an essential prerequisite for any waste management strategy. Though there has been a range of variations of the hierarchy of options currently in use basically, the options are similar and have been used as a policy guideline that has formed part of many National Environmental laws and policies- it is the cornerstone of ISWM. Below is an explanation of how the hierarchy is adapted

Waste minimization/reduction at source

Waste minimization/reduction is the highest rank in the hierarchy of waste management options. It involves reducing the amount (and/or toxicity) of the wastes produced hence entering the waste stream. Waste minimization or reduction is ranked the highest due to the effectiveness associated with it in terms of reducing the cost for handing as well as the negative environmental health problems that are caused by waste (urbanindia.nic.in/publicinfo/swm/chap2.pdf).

Recycling

Waste recycling involves the separation and sorting of waste material, preparation of these materials for reuse or reprocessing; and the reuse and reprocessing of these materials. As noted (www.scribd.com/doc), recycling is an important element in solid waste management since it contributes to the reduction of the financial, technological as well as human resources required for final disposal of waste.

Waste processing (with recovery of resources i.e. materials (products) and energy)

Waste processing involves alteration of wastes to recover conversion products (e.g., compost) and energy (urbanindia.nic.in/publicinfo/swm/chap2.pdf). The processing of waste materials usually results in the reduced use of landfill capacity (www.scribd.com/doc)

Waste transformation (without recovery of resources)

Transformation of waste, without recovery of products or energy, may have to be undertaken to reduce waste volume (e.g. shredding and baling) or to reduce toxicity (www.scribd.com/doc).

Disposal on land (land filling)

This is given the lowest rank in the hierarchy of waste management options.

Although the hierarchy of waste management options is a useful guideline, using it to determine which options are preferable does not always resulting to sustainability. The logic behind this is that different kinds of solid waste will of course be dealt with in different processes so to deal with the whole range of management stream, a range of waste management options are desirable, White et al (1999).

Having a clear understanding of what waste management hierarchy entails, the discussion below gives an outline and explanation of sound waste management practices based on waste management hierarchy.

Sound waste management practices (based on waste management hierarchy)

According to UNEP 1996, a sound practice in SWM refers to any policy or technology that embodies a reasonable balance of feasible cost effective, sustainable, environmentally beneficial and socially sensitive solutions to SWM problems. Selection of sound practices for SWM is context specific based on factors such as level of development including relative cost of capital, labor and other resources, technological development and human resource development, natural conditions such as topography, soil type, waste characteristics e.t.c, social and political conditions such as the degree to which decisions are constrained by political considerations, degree of importance of community involvement in solid waste management e.t.c. In the selection of sound practices in SWM, it is important for policy makers to direct their resources where they would yield the greatest return to the society. The following part discussion may not cover all the sound solid waste management solid waste management practices but will try to give a summary of a bigger number of them.

Reduction at source

Source reduction would involve all means of reducing the amounts of waste that reaches the drop off points. Waste reduction can be done by all waste generators from big companies to small households. Source reduction takes a number of measures such as product design and packaging to make them easier to reuse, using of existing packaging materials as opposed to new ones, lengthening the usage of products to minimize the frequency of replacement and developing alternatives to disposal such as organic composting (Rotich et al. 2006).

Waste reduction would seem the most effective and easiest way of managing solid waste. In developed countries waste reduction is meant to deal with the issue of lack of enough space for land filling, big municipalities in developing countries also use waste reduction for the same purposes; small municipalities in developing countries can also benefit from waste reduction, in most cases the small municipalities are characterized with inadequate finances for solid waste management. Waste reduction can be used to fix these problems.

The approach has been gradually gaining acceptance though not overwhelmingly successful there have been contributions which cannot be ignored regardless of how minor they are. This can be attributed to the emphasis of mass production and the development of cheap consumer goods have led to people adapting the “throw away culture” whereby instead of reusing the old goods, the consumers go for new products hence increasing the amount of waste in the stream.

Several simple ways of reducing waste can be used both by the residents and businesses as well. This ways include buying only what one needs to buy, repairing old products, repairing old products and buying products which are more reusable and durable. Waste reduction can also be done by donating old items such as clothes to the needy as well as selling them to be sold as second hand clothes or exchanging them with some other goods.

Composting

The waste of many developing countries have a higher composition of organic waste than in the developed countries for example (Hoornweg et al. 1999) estimated that in developing countries, the average city’s municipal waste stream is composed of over 50% organic material, Penjor (2007) on the other hand estimated more than 40%. The nature of organic waste makes it start decomposing immediately after it has been produced. If mixed up with other types of waste, it becomes more difficult to manage the waste due to the odor and also due to the fact that decomposing waste acts a vermin attraction. Composting is an effective and sustainable approach of reducing the amount waste that goes to the drop off points as well as improving environmental health conditions. It’s one element of ISWM strategy that can be applied to mixed municipal solid waste management or separately collected leaves, yard wastes and food wastes. The four basic functions of composting are preparation, decomposition, processing and marketing (Tchobanoglous and Kreith, 2002).

The logic behind composting as far as solid waste management is concerned is to take in natural resources, process them, and close the loops of pollution through improved municipal solid waste systems in connection with urban agricultural activities (Tchobanoglous and Kreith, 2002). Organic composting can be considered one of the low cost ways of dealing with waste. However, regardless of composting being a low cost technology of waste management, it has not been so successful

in most of the countries such as in Africa and Latin America, UNEP (1996), a scenario that can be blamed to low technological advancement which is a basic requirement for successful large scale decomposing. To make these systems successful and sustainable, they have to be designed in economically viable, environmentally sound and socially uplifting ways.

If properly done, organic waste composting has got a number of advantages among them in included being reduction of costs of the disposal facilities, it also prolongs the sites life span, and also reduces the environmental impact of disposal sites as the organics are largely to blame for the polluting leachates and methane problems. This is one of the reasons why solid waste managers in many parts of the world are now exploring ways to reduce the flow of biodegradable materials to landfills, Zurbrugg (2002).

Recycling of inorganic materials

Recycling means any method, technique or process utilized to separate, process, modify, convert, treat or otherwise prepare solid waste so that its component materials and substances may be beneficiary used or reused (http://urbanindia.nic.in/publicinfo/swm/chap2.pdf).

Recyclable materials include papers, glass, metals (ferrous and non ferrous, bulk metals, plastic, vehicular batteries, used motor oils, and cardboard. As stated earlier, recycling of inorganic materials from MSW is often well developed through the activities of the informal sector (Zhu et al. 2009). In America, recycling took a greater significance than just providing an alternative method of treatment of solid waste (Tchobanoglous and Kreith (2002). With the increasing cost of raw materials, recycling provides a cheaper source of raw materials for manufacturing industries. Initially scavenging was driven by poverty and a desire to earn a living. However this has taken another shape. N.G.Os and C.B.O s have been engaging in the activities of sorting and recycling waste.

However solid waste managers should be keen on recycling, keeping it in their minds that placing a large part of the responsibility of solid waste management for community in recycling alone puts an undue burden on recycling and could damage a strong sound recycling initiative if it results in excessive cost or excessive contamination of high value products (Tchobanoglous and Kreith, 2002). With proper arrangements for recycling, it makes it possible to reduce the amount of waste that goes to the drop-off points hence reducing the financial burden of collection, transfer and treatment of waste, recycling also hence to prolong the life of the disposal site since lesser waste reaches there besides other economic benefits.

It should also be noted that the three solid waste management practices explained above are interrelated in a way, sometimes it is difficult to separate them except may be by definition since in most cases one leads to the other and therefore in most cases they are discussed together. For instance as indicated above, source separation or reduction at source is done to allow composting and recycling.

5.1.2 Other coping mechanisms

As it will be noted in the discussion below, there are other coping mechanisms to the problems of solid waste management that have been discussed in studies on solid waste management besides the ones that are discussed above based on waste management hierarchy.

Public participation

As noted by JICA (2005), people's participation is a driving force for sustainable waste management. People are the generators of waste and at the same time the greatest beneficiaries of solid waste management service. Population assuming responsibilities of the municipal authorities and setting up an appropriate institutional and technical waste collection scheme while taking their economic situation in to account is the most realistic and promising approach seen to improve the situation of low population coverage in provision of solid waste management service (Zurbrugg and Schertenieib, 2002). Population assuming the role of local authorities in municipal solid waste management can take two levels i.e. privatization and community participation.

Privatization

Many local government budgets are facing extraordinary challenges as shrinking revenues and rising expenses lead to major shortfalls. One of the most logical responses is to reduce the cost and size of government by concentrating on providing critical municipal services such as police and fire protection (http://www.environmentalistseveryday.org). Many municipalities have in fact turned to privatization as a potential solution. It is believed that through privatization of waste collection, disposal and recycling the private sector will provide improved service at a lower, increase efficiency among other benefits. However, financial picture is cleared somewhat when the entire system is turned over to outside local governments will still be held to account if service declines (Zerbok, 2003). Making better use of comparative advantage of the private

sector to provide solid waste collection services is an important step to improving operational inefficiencies in provision of solid waste management services (Zurbrugg and Schertenieib, 2002).

Community Participation

Community participation in solid waste management can be defined as "the process by which individuals and families assume responsibility for their own health and welfare and for those of community and develop the capacity to contribute to theirs and the community development ensuring that their voices are heard in urban environmental management and the decision-making process" (Mwangi, 2000). A successful solid waste management system therefore starts with the participation of the community in the whole process of planning and implementation of SWM practices.

These will ensure that the community who are basically the beneficiaries of SWM service give their opinions and once the decision makers put the opinion of the community members to consideration, the outcomes will definitely reflect the views aspirations and aspirations of the community (Mwangi, 2000). This is very important in avoiding situations whereby the decision makers provide services that do not meet the needs of the community hence might end up losing a lot of money with no positive outcomes.

In addition to involving the community members in the planning process, they can also be involved in other levels such as primary waste collection (neighborhood wide collection and storage), administering and financing the primary collection system, planned cooperation with municipal service agencies, to ensure a reliable transfer of waste from primary to secondary cycle, development of recycling activities within the community and development of income generating activities through processing and upgrading of waste materials and development of local industries. Community participation in primary waste collection can be manifested in the efforts of the community to collect and transport waste to a few central places, where the municipal refuse–collection service will remove it for final disposal elsew - this requires co–operatio from the whole community and special tasks for a few individuals (Mwangi, 2000). Community participation can also be manifested in the efforts of the community to extract certain materials from the waste for commercial or manufacturing purposes (recycling) - this requires separate storage of certain items so that these materials can be recycled with the least possible soiling (Mwangi, 2000).

Partnerships

Mwangi (2000) defined partnerships as "cooperative working arrangements aimed at achieving a specific objective." Municipal governments are responsible for the provision of public services solid waste management included. However due to rapid rate of urbanization especially in developing countries among other factors mentioned earlier in this article, providing solid waste management has become a problem for many municipal governments. Partnerships have proven to be a sort of a solution to this problem. This is where different actors take part in SWM activities helping to relieve municipal governments the burden of providing the service.

Improving efficiency

As noted by Dijk and Kwarlenge (2007), economic and technical efficiency are a key to attain a sustainable solid waste management system. This therefore means that efficiency of solid waste management system has to be measured by productivity of the system. Efficiency in SWM ensures financial sustainability of the system. Productivity of a solid waste management system can be achieved through planning collection routes, vehicle scheduling and operation, supervision of operations and monitoring and enforcement of the role of local authorities.

Capacity building

Insufficient capacity is a fundamental impediment to sound solid waste management programs in much of the developing world. Operating an efficient, effective, environmentally sound municipal solid waste management program requires building administrative capacity for government and private sector players and technical capacity for designing, operating, maintaining, and monitoring each part of the process.

Often those people working in solid waste management- private sector companies, NGOs, and government entities lack technical and financial knowledge of solid waste management. Training that builds human resource and institutional capacity for all stakeholder groups at appropriate levels should be a part of every waste management project. Peer-to-peer training for everyone from waste-pickers to local government officials has proven effective in extending and sustaining these programs.

Generally and as it is the case in the discussion above, coping mechanisms are determined by the problems. However, a number of factors influence in a way the choice of coping mechanisms applied in a certain setting as it will be discussed below:

6 FACTORS THAT INFLUENCE THE CHOICE OF COPING MECHANISMS

The discussion below is about some of the factors that influence the choice of coping mechanisms in the field of solid waste management. Most of the researchers on the topic of solid waste management mention that solid waste management is "context specific" at one point of their study or another. According to Coffey and Coad (2010), one of the main reasons for difficulties in the field of solid waste management is the failure to recognize the differences in geographical regions, nations, between cities and even within a city. Bernstern (2004) stated that the specific local and country context defines the municipal solid waste management needs of a particular society. Majale (2011) also made the similar remarks on the subject, according to her; arrangements for solid waste management service in the urban centers have evolved in direct response to locally specific conditions.

From the above remarks, it can be concluded that the nature of problems facing the field of solid waste management differs from one place to another and therefore different coping mechanisms which best suits their specific context are applied. The differences in the coping mechanisms can also be explained by the facts that cities are different and solutions to a problem in one city might not apply to another regardless of the problem being similar (U.N Habitat, 2011). However other factors than just problems can explain the unique coping mechanisms as discussed below;

Waste characteristics

Waste characteristics both in terms of quantity and composition determine solid waste management of a particular place. The reason why waste characteristic vary from one place to another can be explained by the factors discussed below;

Cooking and eating habits

In most cases, the difference is determined by whether the food is sold prepared or not. In some countries, food like poultry is sold alive and some vegetables e.g. maize are sold with additional materials to the part that is to be consumed. It can therefore be concluded that different kind of food produce waste with different characteristics as well as in terms of volume and characteristics (Coffey and Coad, 2010). Cooking methods also has a major impacts on the characteristics of waste, for instance solid fuel creates the need to use papers which otherwise may have been discarded, hot and abrasive ashes affect the characteristics of waste of waste as well as damaging plastic containers, liquid fuel on the other hand may not have all this (Coffey and Coad, 2010).

Social and economic factors

The way of life of people in most cases determines the amount and the characteristics of waste that they generate as well as how they handle waste. Differences in lifestyle can be big sometimes even within a city. More literate people may tend to buy magazines and newspapers, more affluent people are more likely to discard durable items that become obsolete instead of repairing them. The use of domestic servants may also have an impact on the characteristics of waste generated in a particular household (Coffey and Coad, 2010).

Economic activities

The economic activities of a certain urban area also influence the choice of the coping mechanisms applied in that particular setting, for instance composting will be a more preferred coping mechanism in a more agricultural area than in a less agricultural area, for instance in some towns, much of the waste is also fed to the livestock and poultry (which is a sub-conscious way of dealing with the problems in waste management- determined by the economic activity, in this case poultry keeping) (Coffey and Coad, 2010).

Culture

Culture provides the context or stage setting within which human activities operates; its impacts can therefore touch a host of societal functions including management of solid waste. Culture differs from one group of people to another group. Culture influence on the choice of coping strategies to the problems facing the field of SWM can be manifested well in holism and individualism ways of life. In holism kind of life, it is possible for stakeholders to have successful community participation in SWM since the communities live as one, however in the individualistic way of life, it is difficult to involve the community members since every person lives his or her own life, such activities as neighborhood waste collection and community

product upgrading to earn income are very possible in a holism living community but on the other hand, these activities are very difficult to execute in a community where everyone lives his or her own life (www. zendergroup.org).

Availability of market for recycled products

As indicated earlier, for recycling to be successful there is need for market for the products recycled, if there is no market for the products recycled, then it makes no sense for the commercial recyclers to do their work, on the other hand , where market is readily available it acts as an incentive for the execution of recycling activities

Having looked at the major problems facing the field of solid waste management and the coping mechanisms that the different stakeholders use to cope with the problems and the other factors that influence the choice of coping mechanisms, the discussion below is on the conceptual framework which article proposes.

7 CONCEPTUAL FRAMEWORK

Conceptually, this article proposes ISWM framework. ISWM framework recognizes three main dimensions i.e. stakeholders, system elements and sustainability aspects.

As indicated earlier, ISWM framework recognizes the more understood elements of waste management as well as the less understood elements of waste management namely waste reduction, reuse, and recycling and composting. These elements are outlined and explained well in the concept of waste management hierarchy. As mentioned earlier, current thinking on the best methods to deal with waste is centered on a broadly accepted 'hierarchy of waste management'.

ISWM also calls for the integration of different stakeholders who of course play different roles and apply different measures in the provision of solid waste management services.

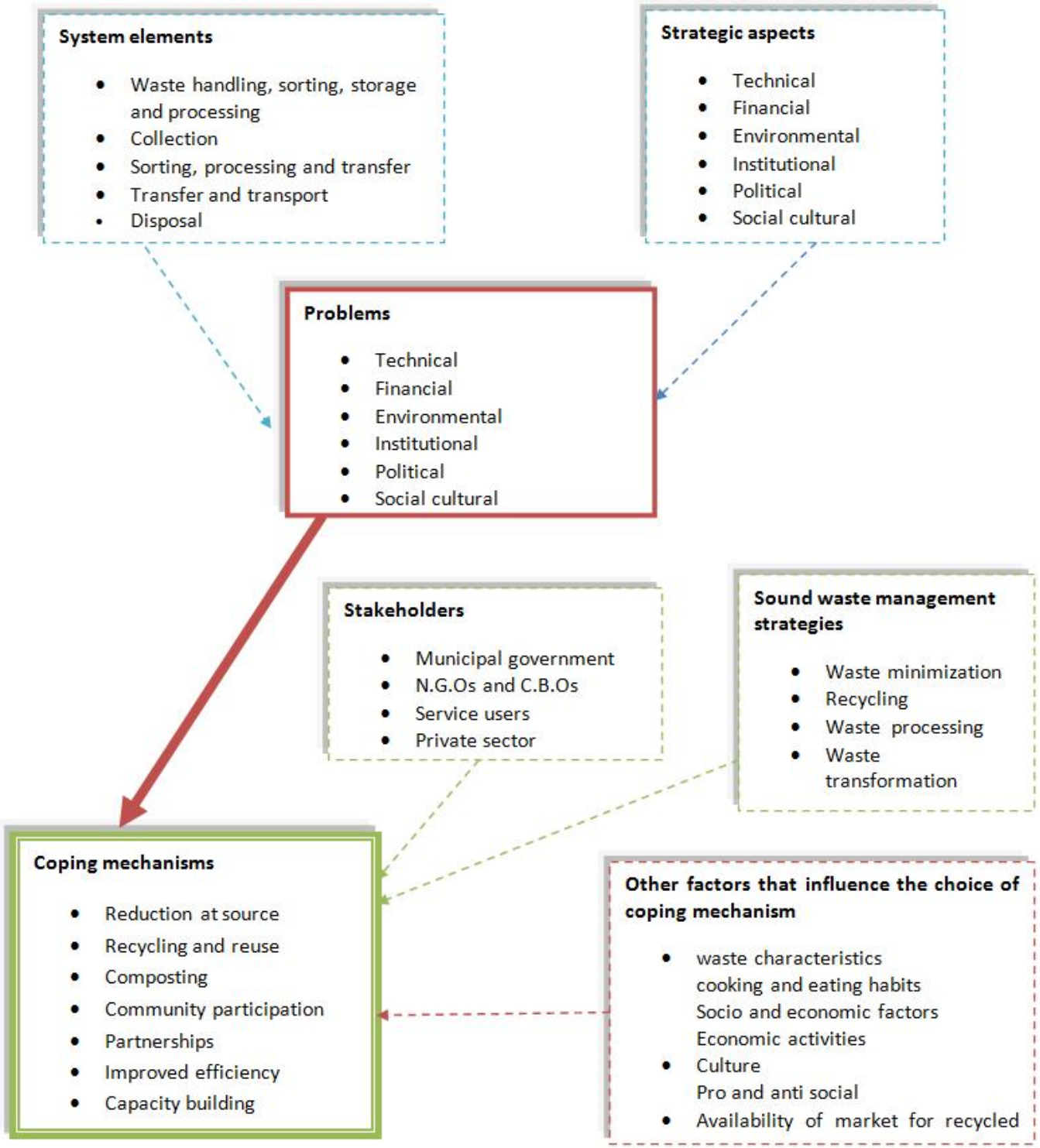
The figure below is a conceptual framework for problems and coping mechanisms in SWM. The problems identified in solid waste management in this area are based on the strategic aspects of solid waste management and solid waste management system. Stakeholders (in most cases but not always) use the hierarchy of waste to select the coping mechanisms. Coping mechanisms on the other hand are determined by the problems; however the conceptual framework also shows the other factors that influence in any way the choice of the coping mechanisms.

8 REFLECTIONS ON THE CONCEPTUALAND THEORITICAL REVIEW

This article provides the a better understanding of the problems that the developing countries are facing as far as SWM is concerned as well as the coping mechanisms adopted to cope with the problems facing the field of SWM. The review has clearly indicated the problems that the developing countries are facing in the field of SWM. Some of the authors however discuss the problems as specific problems while the others discuss the problems as umbrella problems. .

The review has also clearly indicated the coping mechanisms which in this case were based on the waste management hierarchy and stakeholders under ISWM hierarchy; however it is worth noting that not all stakeholders in SWM are involved in the function, the involvement depends on the specific context. However, ISWM have just given an outline of the system elements , strategic aspects and stakeholders and provided some principles guiding the framework, however it should be noted that all that is outlined in the framework can apply in all the contexts as mentioned earlier some system elements are more favored by the existing local conditions of a particular place, also the waste management hierarchy has given an outline of the most preferred to the least preferred without considering that there are some waste management practices that are more applicable in some areas due to the existing local conditions regardless of whether they are preferred as provided by the hierarchy or not. The two frameworks should therefore have some considerations on the features of the specific context and may include other factors that influence the choice of waste management strategy with the corresponding strategy so that it is easy for the waste managers to select waste management strategy that fits their local context instead of scenarios where they apply some strategies that later fail to work for instance the two frameworks have given composting as a strategy for managing solid waste, however without the influencing factor which in this case is economic activity and specifically agriculture some municipal corporations might apply the strategy in areas where there are no agricultural activities taking place hence end up failing due to lack of market for their products

Figure 3: Conceptual framework for identifying problems and challenges and different coping mechanisms by different stakeholders by authors (2014) based on literature review.



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